

EXHIBIT D

Investigation into the Legitimacy of Reported Cryptocurrency Exchange Volume

Alameda Research

July 3, 2019

1 Introduction

Determining how much volume actually occurs on cryptocurrency exchanges has been a notoriously difficult problem to solve throughout the last few years. It's well-established that many exchanges likely engage in practices to inflate the volume they report in order to drive interest in their platforms and to attract new customers. However, there's been little agreement about which exchanges, exactly, are engaging in these behaviors, as well as to what extent they're doing so.

Several parties have sought to answer these questions, and to provide that information to the public to help them make informed decisions about crypto trading. CoinMarketCap is a very popular website devoted to answering these (and other) questions about how much volume trades in each currency pair on every crypto exchange. While CoinMarketCap takes steps to try to identify exchanges which it believes not to report their own volume correctly (for instance, many exchanges or currency pairs are marked with asterisks on CoinMarketCap to indicate that CoinMarketCap doesn't necessarily believe the numbers they're reporting), as demonstrated in this paper, we believe it's possible to take more. Other, similar sites exist as well, ultimately succumbing to much the same failings.

Bitwise Asset Management, a cryptocurrency index fund located in San Francisco, CA, has released a popular series of reports detailing their view of the veracity of exchanges' crypto trading volume. While they identify many of the same exchanges as this paper does whose volume appears fraudulent, their methods prove insufficient insofar as they discard, for instance, much Chinese volume which is legitimate. This paper uses additional methods and sources of data to paint a more complete picture of the worldwide cryptocurrency trading landscape.

2 Data Sources

Alameda Research is a quantitative cryptocurrency trading firm with offices around the world. Our trading systems depend on scraping an enormous amount of data from most of the major exchanges in the world using REST API, FIX API, and websocket-based connections; those data can be used to determine whether exchanges' claims are even possible. We store historical order books, the exchanges' reported trading data, as well as our own trading data for most of the world's largest crypto exchanges. Note that many exchanges included in this study do not make their trading data easily digestible, so we were unable to apply some tests to them. There are other exchanges which do make their data available in some capacity but which we've not taken steps to digest (typically because we do not believe their liquidity is real or otherwise worthwhile for our own trading), so we also did not apply some tests to those exchanges.

In addition, we gathered data about each exchange by cataloguing the trades reported on its own market pages, as well as the orders visible on its order books on those same market pages. All data used are from May 18, 2019 through May 25, 2019.

3 Methodology

In order to ascertain how much volume actually trades on the top cryptocurrency exchanges each day, we developed six criteria by which we judged each exchange we considered. We developed those criteria *a priori* in order not to bias our methods toward or against exchanges about which we had preconceived notions or other biases. Each criterion, when applied to a given exchange, will determine either that that exchange passes, fails, or cannot be adequately judged to have passed or failed. Those criteria are described below.

3.1 Criterion 1: Manual Investigation of Website Trading History

The market pages on crypto exchanges tend to share a few features with one another. Most of them display real-time trade data, updating each time a trade occurs between two parties. Except in the case where both parties involved in a trade place their offsetting orders at the exact same time (or, close enough that the exchange hasn't updated their order book), any trade that occurs must correspond to an order which was previously visible on the order book, and which, after the trade occurs, disappears from the order book. While we do expect that some trades will in fact correspond to simultaneous order placement on both sides, the vast majority of legitimate trades which occur will correspond to orders that did exist on the order book prior to the trade printing.

However, many exchanges' market pages display many trades which never appeared anywhere on their order books prior to the prints themselves occurring. Trades print significantly larger than any orders that exist on the order books, at prices squarely in

the middle of the order book both before and after the trades. In some cases, we've been able to trace exchanges' trade histories to just be slightly time-delayed versions of other exchanges' trade histories, suggesting they're just relaying them and presenting them as though they occurred on their own exchanges.

Accordingly, in judging an exchange by this criterion, we manually visited some of each exchange's most reportedly liquid market pages and assessed the plausibility of their trade histories relative to their order books. An exchange is considered to fail this criterion if more than 10 per cent of its trades by volume did not appear on its order books prior, or if we could identify its prints as time-delayed relays from other exchanges. Otherwise, the exchange is considered to have passed this criterion. Additionally, any exchange where most of that exchange's volume can be easily classified to derive from transaction mining is considered to fail according to this criterion. This is because trades which derive from transaction mining essentially constitute parties wash trading for zero fees (because fees are rebated with the exchange's own token), and do not represent a typical trade in which one party is buying a coin and the other is selling it – the end result is users gain free exchange tokens, and the exchange is able to report elevated volume numbers.

This criterion is the most broadly applicable, since most crypto exchanges make their market pages available to the public (including those whose data either isn't easily digested or which we do not digest). Accordingly, for many of the exchanges we looked at as part of this study, this is the only criterion we were able to apply to them.

3.2 Criterion 2: Fraction of Prints which Cross the Best Bid and Offer (BBO)

This criterion is an algorithmic variation on part of Criterion 1. We wrote a script which, for each trade reported by the exchange with price P and size X , checked whether the most recently-reported orderbook from the exchange contained either bids with size totaling at least X with average price (after accounting for fees) at least P , or offers with size totaling at least X with average price at most P . If neither of these conditions is met, we determine that there's an increased chance that the trade was not legitimate (as described above in Criterion 1), and if enough trades are determined to be potentially illegitimate in this way, we determine that the exchange's volume is likely categorically suspect.

Note that this metric leaves significant room for error. If an exchange has delay in updating their reported order books (as most do, to some small degree, at least), their printed trades will occasionally happen at prices not conforming to our limits, even if they are legitimate. Accordingly, our thresholds for determining whether an exchange is legitimate according to this metric are quite conservative – we determine that an exchange's volume is likely legitimate according to this criterion if more than 50% of its trades occur at acceptable prices (and thus that it passes the criterion), and we determine that its volume is likely illegitimate if less than 5% of its trades do. Otherwise, we do

not consider the exchange to pass or fail the criterion.

3.3 Criterion 3: Comparison of Hourly Volume to Hourly Volume of Exchanges Widely Accepted as Legitimate

In general, crypto exchanges see increases and decreases in volume at the same times. For instance, during times of increased price volatility, most crypto exchanges see above average volume when the largest players in the space all increase their volumes at the same times. Accordingly, when one exchange sees a massive spike in volume during a period when other exchanges don't see anything similar, especially those exchanges which are widely believed to have mostly (or all) legitimate volume reporting, we consider that that outlier exchange's reported volume during that spike period is likely fake. Note that, if any exchange is not operational constantly, we consider only the hours during which they are regularly operational in using this criterion.

In order to determine exchanges whose volume differs significantly from other, more reputable exchanges' volume, we established a set of exchanges well-established as legitimate because of regulations that other exchanges do not have. These exchanges are: Coinbase, Poloniex, Bittrex, Gemini, Kraken, Bitstamp, and itBit. Each of these is US-regulated and trades significant volume against USD, which lends inherent credibility. Incidentally, they also all pass the other criteria from this report, though this was not a factor in their selection.

With this set of reputable exchanges established, we created a time series by summing their volume together per unit of time (using hour-long time steps over a week-long period), and calculated the correlation of other exchanges' volume by time (using the same time steps) to this time series. If an exchange's volume by time has correlation at least $\rho = .5$, it's considered to pass this criterion. Otherwise, it's considered to fail. Note that this criterion is quite similar to one from Bitwise's report, and was inspired by that.

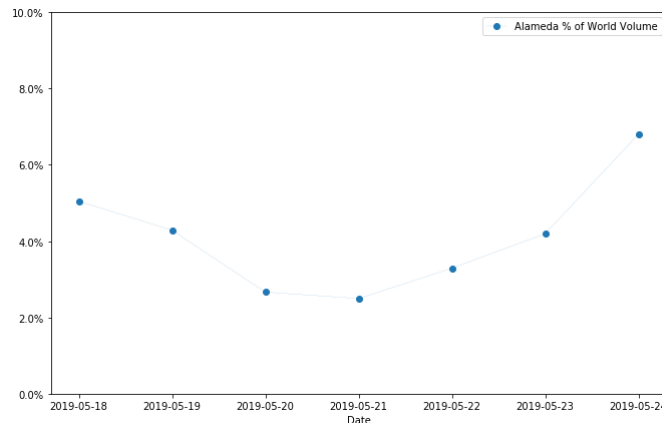
In addition, to address the potential biases introduced by restricting this criterion to comparison to U.S.-based exchanges, after the rest of the tests were complete, we took the largest non-U.S.-based exchanges (given the nature of where crypto flow tends to be, these tend to be China-based) which we determined to be largely legitimate, added them to the set of reputable exchanges, and re-ran the test. Results for that test are included below as well.

3.4 Criterion 4: Comparison of Alameda Research's Volume on an Exchange to its Typical Volume

Alameda Research trades significant volume on every major crypto exchange, totaling over \$500M USD daily, which means we're scraping most of the data all those exchanges make available. Our algorithms are, in many ways, close to exchange-agnostic, insofar

as they allocate capital according to perceived available liquidity, and they make trades according to the same metrics. We also trade virtually every cryptocurrency which sees significant volume anywhere, so our trading on an exchange doesn't tend to depend on which coins it focuses most heavily on.

Indeed, below is a graph depicting our fraction of daily (reported) volume on the well-regulated, U.S.-based exchanges mentioned above:



Given that, we expect that the amount of an exchange's volume we are one side of should be pretty consistent across exchanges (except in certain exceptional cases where, e.g., a bizarre fee structure might interfere with that). If we trade significantly less than our average fraction of some exchange's reported volume (and our own trading volume is unambiguous, since we have access to correct versions of our own trading data), we consider this to be a sign that much of that reported volume is not legitimate. Specifically, if we trade more than .5% of an exchange's reported volume, we consider that exchange to pass according to this criterion, and we consider it to fail if we trade less. We don't consider it to pass or fail if we don't trade on the exchange.

3.5 Criterion 5: Comparison of Total Exchange Order Book Depth to Its Volume

We first establish some definitions:

- For a market between two coins C_1 and C_2 (C_1 is the *currency* and C_2 is the *price currency*), the *relevant order book threshold* σ_t at time t is the sum of the hourly standard deviations (in terms of USD) of C_1 and C_2 . This roughly represents the furthest away from the current bid and offer one would expect the market might see trades at in the very near future.
- For that same market, define the *order book depth* to be the total of all the orders on the order book with price within σ_t of the best bid and offer
- Define that market's *order book ratio* to be the ratio between the order book depth and the exchange's reported average daily volume for that market.

For this criterion, we sum the order book depths from all an exchange's markets, and calculate the ratio between that sum and the exchange's total reported average daily volume. If this ratio is at least .005, the exchange passes this criterion. Otherwise, it fails.

3.6 Criterion 6: Fraction of Exchange's Markets with Reasonable Order Book Depth Compared to its Volume

For this criterion, we look at the order book ratios (as defined above, in the section on Criterion 5) for all the markets on each exchange. We classify a given market on an exchange as "real" if its order book ratio is at least 10^{-6} . We then classify a given exchange as passing this criterion if at most 5% of its markets are so classified as fake. We determine that the exchange fails this criterion otherwise. Note that 10^{-6} was chosen to be a very conservative threshold, so this criterion is a more accurate metric for determining that an exchange has fake volume than for determining that it has real volume.

4 Results

Below we detail the results of applying each of our criteria to the top exchanges listed on CoinMarketCap as of May 28, 2019.

4.1 Criterion 1

There were many different ways in which exchanges failed this test. Some had many prints going up mid-market, much larger than any orders they had on their order books. Others were reporting other exchanges' prints as their own, on a small time delay. Others did somewhat more sophisticated things, such as slipping in large fake prints only when they have a large number of smaller prints to hide them among.

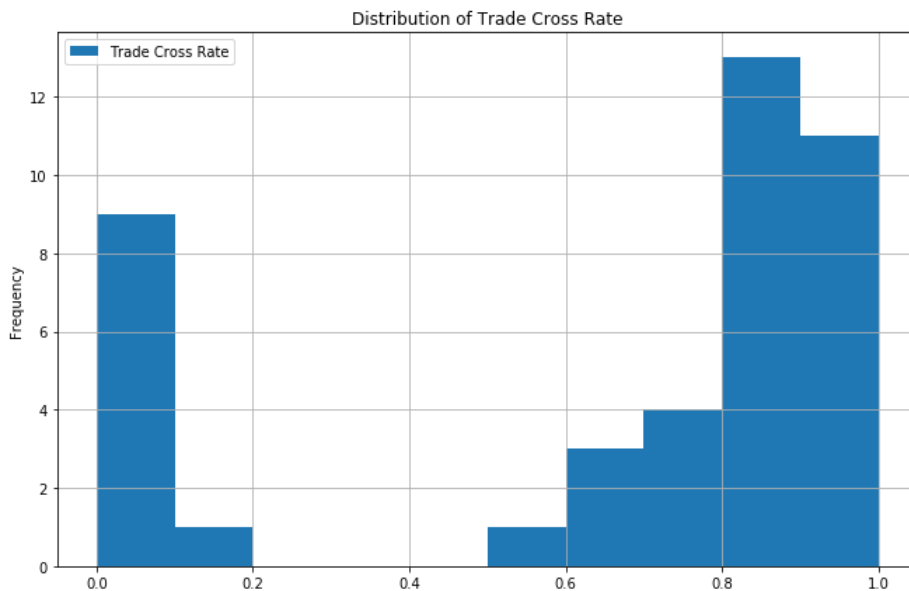
In general, we found that if an exchange failed this test, it would fail almost all the others as well (though many of the exchanges which failed this test don't make their data available, and so we couldn't perform the other tests on them – we don't believe this is a coincidence). Therefore, if an exchange fails this test and it doesn't have its data easily available with which to run the other tests, we immediately consider it to have illegitimate volume.

We've attached screenshots from every exchange which makes them available in an appendix, as well as a short explanation of our analysis of the market page shown in each screenshot. Note that the major exchanges which are known to engage in transaction mining are FCoin, Bitforex, Coinex, Coinbene, and Coinsuper, and they all fail for that reason.

4.2 Criterion 2

The results of applying our algorithmic test of whether an exchange's trades occur at reasonable levels relative to their most recent best bid and offer at least 50% of the time, or less than 5% of the time, appear in the results summary table below. Note that, as discussed above, many exchanges update their order books infrequently enough that broad strokes are necessary in evaluating an exchange according to this metric – that's why the success and failure thresholds are so far apart. Along similar lines, we feel that reporting the precise fraction of prints which confirm to our requirements for this criterion isn't especially informational, so we report only whether each exchange passed, failed, or could not be judged according to this criterion.

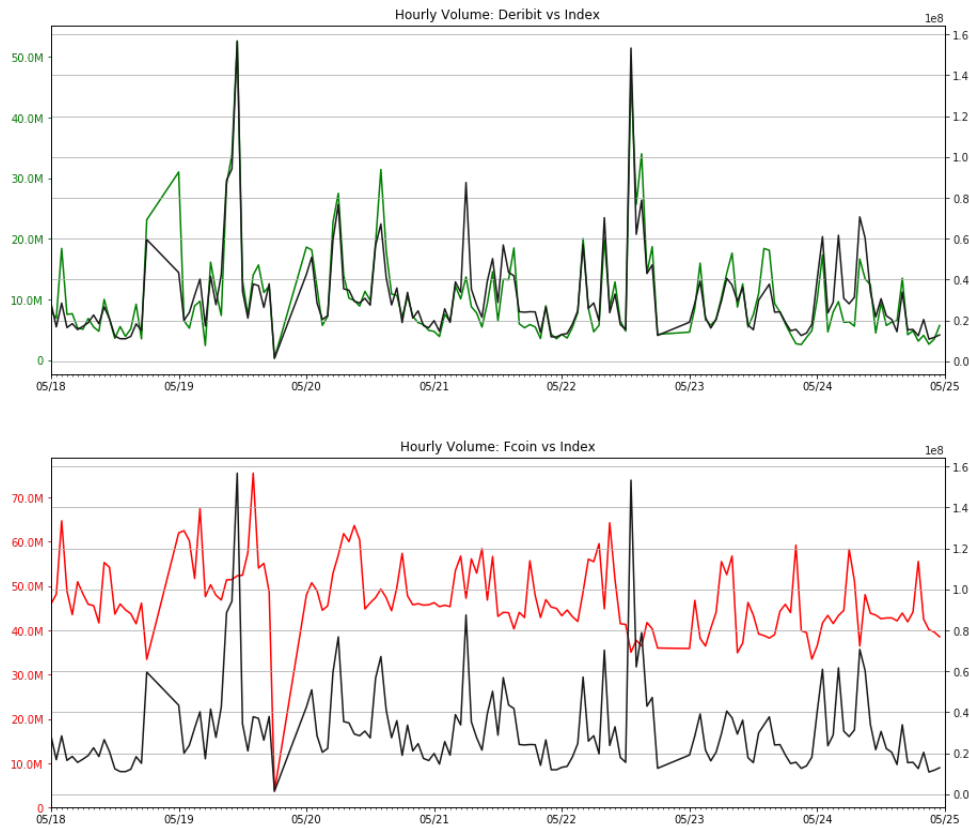
We also include a chart indicating a distribution of how different exchanges performed according to this criterion. Note that the distribution is bimodal, with most exchanges either having close to 0 or close to all of their trades crossing the best bid or offer.



4.3 Criterion 3

Below are the results of applying our test to see whether an exchange's volume by time has strong correlation with exchanges with high regulation and which therefore are likely to be legitimate in reporting their own volume. For exchanges in the group we *a priori* labeled legitimate in conducting this test, we simply removed that exchange from the group of trusted exchanges before applying the criterion to that exchange, but keep that in mind when considering this criterion as applied to those exchanges. Note that we applied this criterion only to those exchanges whose data we consume.

We also included a graph for one example exchange which passed the test, and one which failed. The two graphs demonstrate how closely tied the volume by time of a likely legitimate exchange is to the volume by time of the regulated exchanges, and how untied to that same set of exchanges a likely illegitimate exchange's volume is.



In addition, as noted above, we reran this test after the rest of the tests were complete with the largest non-U.S.-based exchanges we found to have largely legitimate volume. Our goal here was to isolate the real exchanges with mostly non-U.S.-based flow, to combat the biases introduced by using U.S.-centric flow for the first iteration of this test. Of the top few exchanges which passed most of the other tests, OKEEx, Huobi, and Binance (all in our top five by adjusted volume, after which there's a large gap) all stand out as being well known for having mostly Asian flow, so we added these three exchanges to the index of trusted volume by time and redid the test. The only exchanges whose results change as a result of including those other exchanges were HitBTC, Upbit, and Coinex, all of which fail the test with just the U.S.-based exchanges, and pass when the others are included. Given that HitBTC and Upbit passed other tests, this suggests that the criterion is more robust when OKEEx, Huobi, and Binance are included, so the results from that iteration are what we use for our final determination.

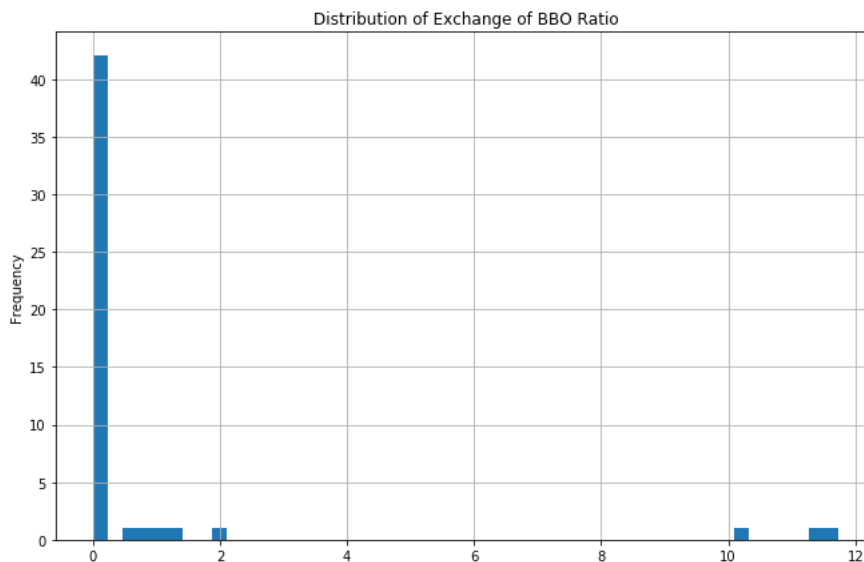
4.4 Criterion 4

Below are the results of applying our test to see whether Alameda Research's volume on an exchange is at least .5% of that exchange's reported volume. Note that we applied this criterion only to those exchanges on which Alameda Research trades regularly. Note also that we do not include Alameda's exact fraction of any exchange's reported volume, in order not to reveal any of the firm's sensitive information.

4.5 Criterion 5

Below are the results of applying our test to see whether the ratio between the sum of all an exchange's order book depths and its reported average daily volume is at least .005. Note that we applied this criterion only to those exchanges whose data we consume.

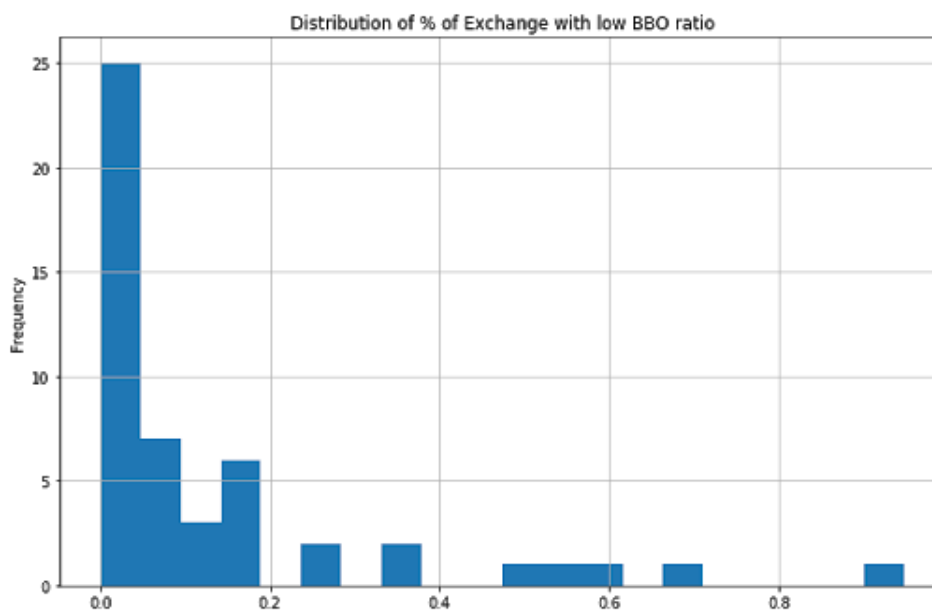
We also include a chart indicating how many exchanges had different ratios between the sum of their order book depths and their reported ADV.



4.6 Criterion 6

Below are the results of applying our test to see whether at most 5% of an exchange's markets have order book ratio less than 10^{-6} . Note that we applied this criterion only to those exchanges whose data we consume.

We also include a chart indicating how many exchanges had different sorts of order book ratio failure fractions.



5 Results Summary

Below is a table summarizing the results of applying each criterion to each exchange which did not fail according to criterion 1 (all of those end up scoring 0 overall anyway), as well as a final conclusion about each exchange (again, every exchange not listed in this table has failed to the point where we assign it a score of 0, meaning we believe approximately 0 of its reported volume is real). In order to arrive at that final conclusion, we assigned weights to each of our criteria according to its relative importance in determining whether an exchange's volume is real *a priori*, i.e. before we had observed the results of any of our tests. We assigned a weight of 1 to all criteria except for 1, 2, 5, and 6. We assigned criterion 1 a weight of 0, because we consider it to be an “auto-fail” overall metric, and, accordingly, almost every exchange which passed any tests (and which appears with nonzero adjusted volume in our results) would have to have passed it. For criterion 2, we assigned it a weight of 2 on the basis that our thresholds for success and failure are quite far apart from one another, and also on the basis that failing by this criterion is a large red flag insofar as printing midmarket trades is the most natural (and well-known) trick exchanges use to fake their volume. We assigned weights of .5 to each of criteria 5 and 6 on the basis that they're largely measuring the same effect (or, at least, analogous effects) and we expect that they combine to form roughly a metric as strong as the other criteria.

After we arrive at scores for each exchange, we assign it a *multiplier* of 1 if it scores at least 4, 0 if it scores at most 1.5, and .5 otherwise. We then assume its true volume to be its reported volume multiplied by its multiplier. The reason we use such coarse numbers (approximating everything between entirely fake and entirely real as .5) is a

reflection of the uncertainty our criteria leave us with, and the fact that we do not wish to overfit and make specific claims about exchanges our criteria potentially do a poor job of categorizing. We chose .5 specifically (and not, for instance, a number closer to 0 or closer to 1) because we believe that an exchange which passes some of our tests and fails others definitely has some significant real reported volume and some significant fake reported volume, but, again, we're hesitant to make much more precise claims.

Note that, in the table, asterisks denote exchanges which failed the first criterion due to engaging in transaction mining, and the reported volume includes derivatives volume.

6 Conclusions

While our methods are not foolproof, we believe they paint the most accurate picture of the true nature of cryptocurrency trading volume that anyone has made publicly available as of yet. We hope that many different sorts of parties can make use of this information – traders can make more informed decisions about which exchanges to turn to for liquidity, exchanges can better understand their place in the landscape, and coin projects can more easily gauge how much interest exists in trading their coins.

Going forward, Alameda plans to maintain a website with results like these updating daily for all the major crypto exchanges. We'll also expand to categorize the flow even further, broken down by coin rather than just by exchange. We also plan to expand the set of criteria used to categorize exchanges (and narrow down the .5 multiplier for exchanges with partially real volume to be much more exact) over the coming months in order to further refine our methods as the cryptocurrency market continues to evolve rapidly.

Exchange	Correlation	Result
BitMEX	96.8%	Pass
CoinTiger	92.8%	Pass
Kraken	92.3%	Pass
Bitstamp	91.9%	Pass
Deribit	90.0%	Pass
Liquid	88.2%	Pass
bitFlyer	86.8%	Pass
Coinbase Pro	86.3%	Pass
OKEx	85.4%	Pass
Coincheck	85.3%	Pass
Huobi Global	83.5%	Pass
LBank	82.6%	Pass
Bitfinex	81.3%	Pass
Zaif	81.1%	Pass
Binance	77.4%	Pass
Korbit	77.3%	Pass
Coinone	77.2%	Pass
itBit	75.3%	Pass
Gemini	73.8%	Pass
KuCoin	72.7%	Pass
ZB.COM	70.5%	Pass
Poloniex	67.6%	Pass
Bitbank	66.8%	Pass
CEX.IO	66.0%	Pass
Huobi (HBUS)	63.8%	Pass
GOPAX	63.4%	Pass
Bittrex	60.9%	Pass
Exmo	56.9%	Pass
Gate.io	51.3%	Pass
HitBTC	44.3%	Fail
Upbit	39.3%	Fail
FTX	37.8%	Fail
Bitrue	37.3%	Fail
CoinEx	34.4%	Fail
OKCoin	31.1%	Fail
Bit-Z	24.3%	Fail
Bitso	24.2%	Fail
EXX	15.0%	Fail
BTCBOX	14.5%	Fail
BitForex	13.9%	Fail
Bibox	13.6%	Fail
IDAX	11.8%	Fail
FCoin	10.7%	Fail
BigONE	10.7%	Fail
Kryptono	4.9%	Fail
CoinBene	4.3%	Fail
Coinsuper	-1.5%	Fail
Bithumb	-9.1%	Fail

Table 1: Criterion 3 Results

Exchange	Correlation	Result
OKEEx	98.9%	Pass
Huobi Global	98.4%	Pass
CoinTiger	94.8%	Pass
LBank	93.8%	Pass
Bitstamp	89.0%	Pass
Bitfinex	88.4%	Pass
Coinone	88.2%	Pass
BitMEX	87.0%	Pass
bitFlyer	85.7%	Pass
Coinbase Pro	85.1%	Pass
Korbit	84.2%	Pass
Kraken	83.5%	Pass
Bitbank	82.3%	Pass
ZB.COM	82.2%	Pass
Liquid	80.9%	Pass
GOPAX	80.9%	Pass
Zaif	79.6%	Pass
Deribit	79.0%	Pass
Gate.io	77.1%	Pass
KuCoin	76.9%	Pass
Binance	76.5%	Pass
Poloniex	76.3%	Pass
Coincheck	76.0%	Pass
Bittrex	74.5%	Pass
itBit	73.3%	Pass
Gemini	73.2%	Pass
Huobi (HBUS)	72.4%	Pass
Upbit	64.5%	Pass
Exmo	63.7%	Pass
CEX.IO	60.0%	Pass
CoinEx	57.0%	Pass
HitBTC	56.5%	Pass
Bittrue	35.1%	Fail
FTX	34.0%	Fail
OKCoin	31.7%	Fail
EXX	31.6%	Fail
Bit-Z	28.6%	Fail
BTCBOX	24.8%	Fail
Bitso	24.3%	Fail
BitForex	21.8%	Fail
Kryptono	13.0%	Fail
BigONE	12.6%	Fail
FCoin	12.5%	Fail
IDAX	5.7%	Fail
CoinBene	4.6%	Fail
Bithumb	-2.2%	Fail
Bibox	-2.7%	Fail
Coinsuper	-8.4%	Fail

Table 2: Criterion 3 Results with Chinese Exchanges in Index

Exchange	Result
Bibox	Fail
BigONE	Fail
Binance	Pass
Bitbank	Pass
Bitfinex	Pass
bitFlyer	Pass
BitForex	Fail
Bithumb	Pass
BitMEX	Pass
Bittrue	Fail
Bitso	Fail
Bitstamp	Pass
Bittrex	Pass
Bit-Z	Fail
BTCBOX	Pass
CEX.IO	Fail
Coinbase Pro	Pass
CoinBene	Fail
Coincheck	Fail
CoinEx	Fail
Coinone	Pass
Coinsuper	Fail
CoinTiger	Fail
Deribit	Pass
Exmo	Fail
EXX	Fail
FCoin	Fail
FTX	Pass
Gate.io	Pass
Gemini	Pass
GOPAX	Pass
HitBTC	Fail
Huobi (HBUS)	Pass
Huobi Global	Pass
IDAX	Fail
itBit	Pass
Korbit	Pass
Kraken	Pass
Kryptono	Fail
KuCoin	Pass
LBank	Fail
Liquid	Pass
OKCoin	Pass
OKEx	Pass
Poloniex	Pass
Upbit	Pass
Zaif	Pass
ZB.COM	Pass

Table 3: Criterion 4 Results

Exchange	Ratio	Result
Coinsuper	16.5001%	Pass
IDAX	9.2568%	Pass
FTX	1.5523%	Pass
Bittrue	1.2847%	Pass
Huobi (HBUS)	1.1684%	Pass
Bitso	1.0661%	Pass
OKCoin	0.2397%	Pass
CEX.IO	0.1990%	Pass
Poloniex	0.1745%	Pass
itBit	0.1483%	Pass
Gemini	0.1306%	Pass
Bittrex	0.0978%	Pass
Bitfinex	0.0973%	Pass
Exmo	0.0792%	Pass
BitForex	0.0742%	Pass
Coinone	0.0559%	Pass
Kraken	0.0528%	Pass
KuCoin	0.0473%	Pass
Bitstamp	0.0471%	Pass
BigONE	0.0437%	Pass
GOPAX	0.0322%	Pass
Bibox	0.0214%	Pass
Gate.io	0.0211%	Pass
Coinbase Pro	0.0203%	Pass
Korbit	0.0196%	Pass
CoinEx	0.0193%	Pass
HitBTC	0.0167%	Pass
Liquid	0.0165%	Pass
bitFlyer	0.0164%	Pass
Zaif	0.0158%	Pass
BTCBOX	0.0140%	Pass
Coincheck	0.0109%	Pass
Bitbank	0.0093%	Pass
Binance	0.0092%	Pass
Huobi Global	0.0079%	Pass
Upbit	0.0059%	Pass
Bithumb	0.0043%	Fail
ZB.COM	0.0022%	Fail
OKEx	0.0022%	Fail
Bit-Z	0.0014%	Fail
LBank	0.0008%	Fail
CoinBene	0.0007%	Fail
CoinTiger	0.0003%	Fail
EXX	0.0001%	Fail
Kryptono	0.0001%	Fail

Table 4: Criterion 5 Results

Exchange	Fail Rate	Result
Coinsuper	0.0%	Pass
IDAX	0.0%	Pass
FTX	0.0%	Pass
Bitrue	0.0%	Pass
Huobi (HBUS)	0.0%	Pass
Bitso	0.0%	Pass
OKCoin	0.0%	Pass
itBit	0.0%	Pass
Gemini	0.0%	Pass
Coinone	0.0%	Pass
Bitstamp	0.0%	Pass
Coinbase Pro	0.0%	Pass
Korbit	0.0%	Pass
bitFlyer	0.0%	Pass
Coincheck	0.0%	Pass
Bitbank	0.0%	Pass
Bitfinex	1.1%	Pass
Kraken	1.3%	Pass
GOPAX	1.9%	Pass
Binance	2.9%	Pass
Bittrex	3.1%	Pass
Zaif	3.3%	Pass
Poloniex	4.3%	Pass
Bithumb	4.8%	Pass
CEX.IO	5.0%	Fail
Liquid	5.9%	Fail
Gate.io	7.6%	Fail
Huobi Global	7.7%	Fail
Exmo	8.2%	Fail
BigONE	8.8%	Fail
Upbit	10.7%	Fail
CoinEx	11.0%	Fail
HitBTC	11.7%	Fail
Bibox	12.8%	Fail
KuCoin	14.5%	Fail
ZB.COM	19.4%	Fail
Bit-Z	21.2%	Fail
BitForex	23.3%	Fail
OKEx	30.4%	Fail
CoinBene	33.2%	Fail
EXX	38.5%	Fail
BTCBOX	50.0%	Fail
LBank	51.7%	Fail
CoinTiger	54.4%	Fail
Kryptono	95.2%	Fail

Table 5: Criterion 6 Results

Exchange	1 (0)	2 (2)	3 (1)	4 (1)	5 (.5)	6 (.5)	Score	Multiplier	Adjusted Volume	Reported ⁺
OKEx	Pass	Pass	Pass	Pass	Fail	Fail	4	1	4,728,575,030	4,728,575,030
BitMEX	Pass	Pass	Pass	Pass	Pass	Pass	5	1	3,392,623,738	3,392,623,738
Huobi Global	Pass	Pass	Pass	Pass	Pass	Fail	4.5	1	3,006,542,737	3,006,542,737
Binance	Pass	Pass	Pass	Pass	Pass	Pass	5	1	2,081,016,687	2,081,016,687
bitFlyer	Pass	Pass	Pass	Pass	Pass	Pass	5	1	1,099,595,656	1,099,595,656
Upbit	Pass	Pass	Pass	Pass	Pass	Fail	4.5	1	963,941,563	963,941,563
ZB.COM	Pass	Pass	Pass	Pass	Fail	Fail	4	1	639,042,531	639,042,531
HitBTC	Pass	Pass	Pass	Fail	Pass	Fail	3.5	0.5	373,352,027	746,704,054
Bithumb	Pass	Pass	Fail	Pass	Fail	Pass	3.5	0.5	289,618,419	579,236,837
Coinbase Pro	Pass	Pass	Pass	Pass	Pass	Pass	5	1	256,392,470	256,392,470
Deribit	Pass	Pass	Pass	Pass	Pass	Pass	5	1	201,854,080	201,854,080
Bitfinex	Pass	Pass	Pass	Pass	Pass	Pass	5	1	189,054,133	189,054,133
Kraken	Pass	Pass	Pass	Pass	Pass	Pass	5	1	176,530,073	176,530,073
Liquid	Pass	Pass	Pass	Pass	Pass	Fail	4.5	1	157,591,833	157,591,833
Bitstamp	Pass	Pass	Pass	Pass	Pass	Pass	5	1	111,182,249	111,182,249
Gate.io	Pass	Pass	Pass	Pass	Pass	Fail	4.5	1	102,461,826	102,461,826
Bibox	Pass	Pass	Fail	Fail	Pass	Fail	2.5	0.5	76,672,934	153,345,868
Poloniex	Pass	Pass	Pass	Pass	Pass	Pass	5	1	72,679,212	72,679,212
Bittrex	Pass	Pass	Pass	Pass	Pass	Pass	5	1	57,226,125	57,226,125
FTX	Pass	Pass	Fail	Pass	Pass	Pass	4	1	50,444,971	50,444,971
Bitbank	Pass	Pass	Pass	Pass	Pass	Pass	5	1	49,742,028	49,742,028
Coinone	Pass	Pass	Pass	Pass	Pass	Pass	5	1	38,576,590	38,576,590
KuCoin	Pass	Pass	Pass	Pass	Pass	Fail	4.5	1	30,212,559	30,212,559
Zaif	Pass	Pass	Pass	Pass	Pass	Pass	5	1	29,076,004	29,076,004
Korbit	Pass	Pass	Pass	Pass	Pass	Pass	5	1	24,738,315	24,738,315
Coincheck	Pass	Pass	Pass	Fail	Pass	Pass	4	1	24,117,968	24,117,968
Gemini	Pass	Pass	Pass	Pass	Pass	Pass	5	1	22,469,480	22,469,480
GOPAX	Pass	Pass	Pass	Pass	Pass	Pass	5	1	11,051,862	11,051,862
itBit	Pass	Pass	Pass	Pass	Pass	Pass	5	1	10,520,527	10,520,527
Exmo	Pass	Pass	Pass	Fail	Pass	Fail	3.5	0.5	8,900,435	17,800,870
OKCoin	Pass	Pass	Fail	Pass	Pass	Pass	4	1	5,465,125	5,465,125
Huobi (HBUS)	Pass	Pass	Pass	Pass	Pass	Pass	5	1	3,717,296	3,717,296
Bitso	Pass	Pass	Fail	Fail	Pass	Pass	3	0.5	1,720,015	3,440,030
CEX.IO	Pass	Pass	Pass	Fail	Pass	Fail	3.5	0.5	881,773	1,763,545
*BitForex	Fail	Fail	Fail	Fail	Pass	Fail	0.5	0	0	1,243,359,949
EXX	Fail	Fail	Fail	Fail	Fail	Fail	0	0	0	1,166,838,742
*CoinBene	Fail	Fail	Fail	Fail	Fail	Fail	0	0	0	1,110,434,739
IDAX	Fail	Fail	Fail	Fail	Pass	Pass	1	0	0	1,032,442,439
Bit-Z	Fail	Fail	Fail	Fail	Fail	Fail	0	0	0	1,023,768,845
LBank	Fail	Fail	Pass	Fail	Fail	Fail	1	0	0	830,758,206
*FCoin	Fail	Pass	Fail	Fail	Fail	Fail	2	0	0	716,393,364
CoinTiger	Fail	Fail	Pass	Fail	Fail	Fail	1	0	0	678,563,870
Kryptono	Fail	Fail	Fail	Fail	Fail	Fail	0	0	0	83,702,624
*Coinsuper	Fail	Fail	Fail	Fail	Pass	Pass	1	0	0	79,809,828
Bitrue	Fail	Fail	Fail	Fail	Pass	Pass	1	0	0	47,665,583
*CoinEx	Fail	Fail	Pass	Fail	Pass	Fail	1.5	0	0	47,132,068
BTCBOX	Fail	Fail	Fail	Pass	Pass	Fail	1.5	0	0	8,569,855
BigONE	Fail	Fail	Fail	Fail	Pass	Fail	0.5	0	0	2,770,409

Table 6: Results Summary

* denotes an exchange which failed Criterion 1 because it engages in transaction mining

⁺ note that reported volume includes derivatives volume and spot volume